

# BETTER USE OF BLOOD IN NORTHERN IRELAND

## Guidelines for Blood Transfusion Practice

January 2001

This booklet has been published by the Clinical Resource Efficiency Support Team (CREST) which is a small team of health care professionals, established under the auspices of the Central Medical Advisory Committee. The aims of CREST are to promote clinical efficiency in the Health Service in Northern Ireland, while ensuring that the highest possible standard of clinical practice is maintained.

These guidelines have been produced for use in Northern Ireland by a small Sub-Group of physicians, haematologists and transfusion medicine specialists. CREST wishes to thank them and all those who contributed in any way to the development of these guidelines.

Special thanks are due to Dr John Galway and Mr Michael O'Hare and in particular, to Dr Kieran Morris who made a major contribution to the production of this booklet.

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## **BETTER USE OF BLOOD IN NORTHERN IRELAND**

### **Introduction**

Ten years ago CREST issued guidance on the use and supply of blood products in Northern Ireland. Since then, there has been an increasing awareness of the need to use blood only when it is essential. In view of this changing environment, CREST decided to revisit its guidelines and a small group of physicians, haematologists and transfusion medicine specialists was established to take this forward (membership is listed in [Appendix 1](#)).

The Northern Ireland Blood Safety Committee is considering other aspects of blood use including:

- Ensuring the establishment and effective working of Transfusion Committees in all Trusts that use blood; and
- Examining the feasibility of reducing the requirement for allogeneic blood by considering cell salvage, pre-operative autologous donation and acute normovolaemic haemodilution.

The guidelines for red cell and neonatal transfusion and massive haemorrhage are of relevance to all Northern Ireland practitioners who use blood. I hope that colleagues will find them useful and that they will use them, where appropriate, to modify their practice. Audit tools are provided for each of the guidelines to facilitate the process.

### **PROFESSOR GARY LOVE**

Chairman of CREST

This introduction was written by the late Professor Love prior to his untimely death on 3rd January 2001.





# **GUIDELINES**

## **FOR**

# **RED CELL TRANSFUSION**



## GUIDELINES FOR RED CELL TRANSFUSION

### Variations in Red Cell Transfusion Practice

There is large variation in transfusion of red cells<sup>1-9</sup>, mostly documented for surgical patients<sup>3, 4, 5, 8, 10-14</sup>. The most representative paper is that from the Sanguis Study Group<sup>3</sup>. To give one example, your chance, as a patient, of being transfused with red cells for primary total hip replacement varies from 30–100% depending upon who carries out the operation. Differences cannot be accounted for by case mix, surgical technique or anaesthetic practices. The differences appear to be surgical team specific. Also poor documentation of red cell transfusions (no greater than 1/3 for post operative transfusions) appears to reflect uncertainty in the minds of prescribing clinicians<sup>3</sup>.

### Preliminary Clinical Studies

There is a profound lack of data in the area of red cell transfusion practice but studies are emerging. A recent review<sup>15</sup> uncovered only six prospective randomised controlled trials of red cell transfusion and five of these lacked statistical power<sup>16-21</sup>. One study comparing a liberal versus a restrictive red cell transfusion strategy in sickle cell anaemia patients demonstrated no difference in the incidence of a sickle cell crisis<sup>20</sup>. A recently published study from Hebert's group<sup>22</sup> looking at transfusion in an intensive care setting suggests that a more restrictive transfusion policy (maintain Hb 7–9g/dl) is as safe as or may be superior to a more liberal transfusion strategy (maintain Hb 10–12 g/dl). Sub group analysis shows improved outcomes in younger patients <55 years and less critically ill patients (APACHE II scores < 20). The study cautions against enrolment bias on behalf of clinicians and failure to recruit patients with significant cardiac disease histories. There is also one other recently published study<sup>23</sup> of orthopaedic patients in which a policy of transfusing to a trigger of 10 g/dl was compared with a policy of transfusing to a trigger of 8g/dl or in response to symptoms. Once again, there was no difference in terms of mortality outcome and this study also looked at rehabilitation and physical activity scores.

### Physiological Adaptations to Anaemia and Problems with Hb Transfusion Trigger

There are many compensating mechanisms which come into play with the development of anaemia<sup>24</sup>. Oxygen delivery is a function of oxygen content (largely circulating Hb or red cell mass) and cardiac output. With decrease in Hb there is an increase in stroke volume and then an increase in heart rate. Tachycardia is only apparent at Hb <7g/dl in healthy fit young adults. There are other physiological changes such as increase in tidal volume, increase in respiratory rate, decrease in peripheral vascular resistance, increased O<sub>2</sub> extraction ratio and increase in 2, 3, DPG which shifts the Hb oxygen dissociation curve to the right with greater offloading of oxygen to the tissues. Red cell transfusion should be given to improve oxygen delivery or prevent tissue hypoxia. The direct measure of this would be intracellular pH or blood lactate/blood base excess as a surrogate marker<sup>24</sup>. These measurements, of course, are not readily available and even in intensively monitored patients measurements such as mixed venous oxygen saturation and arterial oxygenation level are governed by other factors which interact and complicate interpretation. Understandably Hb is used to make decisions about red cell transfusion because it is readily accessible. This will be of value in acute anaemia though Hb can be artificially lowered because of non blood volume replacement. In the context of chronic anaemia, patients may be euvolaemic or hypervolaemic, distorting the Hb measurement. It is probably the case that clinicians do

not take sufficient account of physiological adaptations to anaemia when they are transfusing to a formula to maintain the Hb > 10g/dl.

### **Experimental Evidence**

Experiments in healthy human volunteers which measure oxygen delivery indicate a fall off in oxygen delivery only at low levels of Hb, i.e. 5 g/dl<sup>25</sup>. Similar experiments have been conducted in animals and surprisingly low levels of Hb can be tolerated. Some experiments have induced coronary artery stenosis in animals mimicking coronary ischaemic syndromes in humans and fall-off in delivery of oxygen is perceptible at about twice the level of Hb in non-injured animals. It is incorrect to extrapolate these findings to a clinical setting. In essence no two patients are the same and Hb = 8.5 g/dl in a 21 year old fit healthy young male is a different proposition from Hb = 8.5 g/dl in an 81 year old with ischaemic heart disease. While it is intellectually pure to suggest that a Hb threshold for transfusion of red cells cannot be set and that each patient must be decided upon individually by an experienced clinician with relevant and up to date knowledge, in the real world pragmatic considerations come into play. The best current measure available is venous Hb concentration. The draft UK guideline<sup>26</sup> and all recent guidelines – American College of Physicians 1992<sup>27, 28, 29</sup> – American Society of Anaesthesiologists 1996 – Consensus conference on red cell transfusion 1994 – offer the expert opinion that a universal threshold of Hb = 10g/dl is no longer justified. Red cell transfusion should not be given when the Hb is >10g/dl and equally should not be withheld when Hb is <7g/dl. There may be exceptions in both cases but they need to be justified<sup>30</sup>.

### **Collection of Minimum Data Sets**

There is a common thread in all published guidelines in this area in that they ask for prospective randomised controlled studies comparing Hb thresholds for transfusion of red cells. These studies are beginning to emerge. It is worth noting that end point determination in this area is difficult and it is acknowledged that the FDA is having great difficulty in deciding on licensing for acellular oxygen carrying solutions, such is the imprecision in determining meaningful outcomes<sup>24</sup>. If red cells were introduced as a novel therapy today there would be difficulties surrounding their approval! While guidelines make a common plea for documentation of transfusions in the patients' records, we may have to start by obtaining minimum data sets, including pre transfusion Hb, documentation of transfusion and comment re outcome of transfusion. This information should be shared between hospitals and clinicians and in this way different transfusion strategies can be tested and validated<sup>31</sup>. National guidelines should be adapted locally and transfusion practices and collection of data should be under the direction of the local hospital transfusion committee.

### **The Decision to Transfuse Red Cells**

In deciding whether or not to transfuse red cells the clinician should consider the cause of the anaemia and whether or not it is reversible. Other relevant factors include the absolute level of haemoglobin, the trend in haemoglobin and the rate of change of haemoglobin. The clinician should consider the patient's adaptive responses to anaemia and also the cardio pulmonary reserve of the patient. Where Hb < 7g/dl transfusion should rarely be withheld and conversely where Hb > 10g/dl transfusion should rarely be administered. Intermediate level 7g/dl < Hb < 10g/dl requires individual assessment.

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# GUIDELINES FOR RED CELL TRANSFUSION

## Wall Chart No. 1

1. There is large variation in red cell transfusion practice.
2. There is a lack of good quality clinical data demonstrating effectiveness in this area.
3. Prospective randomised controlled studies are needed.
4. Documentation of red cell transfusions should include the:
  - Blood transfusion compatibility report form
  - Sheets used for the prescription of red cell transfusion and for nursing observation during the transfusion and to be placed in the case notes
  - Indication for the use of red cells
  - Date, number and type used
  - Whether or not it achieved the desired effect
  - Occurrence and management of any adverse effects.
5. Hb/Hct is an imperfect measure on which to base decisions but practically is one that is readily available.
6. There are good physiological adaptations to acute and chronic anaemia which must be understood and factored into any decision to prescribe a red cell transfusion.
7. Red cell transfusion should only be given to improve oxygenation, prevent tissue hypoxia or replace acute blood loss.
8. Reversible causes of anaemia should be treated.
9. Red cell transfusion is rarely indicated at Hb > 10g/dl.
10. Red cell transfusion is usually indicated at Hb < 7 g/dl.
11. A transfusion trigger Hb = 10g/dl can be justified in patients with diminished cardiopulmonary reserve.

## GUIDELINES FOR RED CELL TRANSFUSION

### Wall Chart No. 2

- Always diagnose anaemia
- Treat reversible causes of anaemia

#### Hb Levels

**Hb <7g/dl**

Usually transfuse

**Hb > 7g/dl Hb < 10g/dl**

Individual decision for each patient

- consider likely trend in Hb
- consider rate of change of Hb
- assess symptoms\*
- assess cardiopulmonary reserve

**Hb > 10 g/dl**

Usually do not transfuse

<b>*Symptoms</b>	<b>Signs</b>
fatigue	tachycardia
dyspnoea	orthostatic hypotension
angina	
palpitations	
syncope	

\* Symptoms/signs can also represent adaptive responses

## GUIDELINES FOR RED CELL TRANSFUSION

### Audit Proformas

Request for blood transfusion/collection of blood samples for pre transfusion compatibility testing

1	Who is responsible for the prescribing of blood transfusion?	
2	Who may request blood or blood components?	
3	<p>Is the following information recorded on the blood bank request form?</p> <p>Patient's surname</p> <p>Patient's first name</p> <p>Date of birth</p> <p>Gender of patient</p> <p>Patient identification number</p> <p>Location of patient at time of request</p> <p>Where blood should be sent if different</p> <p>Number and type of blood or blood component</p> <p>Special requirements of blood components</p> <p>Date and time blood components required</p> <p>Transfusion history</p> <p>Obstetric history</p> <p>Patient's diagnosis</p> <p>Reason for request</p>	<p style="text-align: center;"><b>Yes</b>                      <b>No</b></p> <p style="text-align: center;"><input type="checkbox"/>                              <input type="checkbox"/></p> <p style="text-align: center;"><input type="checkbox"/>                              <input type="checkbox"/></p> <p style="text-align: center;"><input type="checkbox"/>                              <input type="checkbox"/></p> <p style="text-align: center;"><input type="checkbox"/>                              <input type="checkbox"/></p> <p style="text-align: center;"><input type="checkbox"/>                              <input type="checkbox"/></p> <p style="text-align: center;"><input type="checkbox"/>                              <input type="checkbox"/></p> <p style="text-align: center;"><input type="checkbox"/>                              <input type="checkbox"/></p> <p style="text-align: center;"><input type="checkbox"/>                              <input type="checkbox"/></p> <p style="text-align: center;"><input type="checkbox"/>                              <input type="checkbox"/></p> <p style="text-align: center;"><input type="checkbox"/>                              <input type="checkbox"/></p> <p style="text-align: center;"><input type="checkbox"/>                              <input type="checkbox"/></p> <p style="text-align: center;"><input type="checkbox"/>                              <input type="checkbox"/></p> <p style="text-align: center;"><input type="checkbox"/>                              <input type="checkbox"/></p> <p style="text-align: center;"><input type="checkbox"/>                              <input type="checkbox"/></p> <p style="text-align: center;"><input type="checkbox"/>                              <input type="checkbox"/></p>
4	How is patient positively identified at the bedside?	

5	When is the sample tube labelled?	
6	Are sample tubes pre-labelled?	Yes <input type="checkbox"/> No <input type="checkbox"/>
7	What is the minimum patient identification set required for sample labelling?	
8	Are addressograph labels used?	Yes <input type="checkbox"/> No <input type="checkbox"/>
9	Is the date and time recorded of sample collected?	Yes <input type="checkbox"/> No <input type="checkbox"/>

**Part2**

Administration of blood and blood components

1	Who has responsibility for prescription of blood and blood components?	
2	Are blood and blood components prescribed on prescription sheets?	Yes <input type="checkbox"/> No <input type="checkbox"/>
3	Is the following information recorded on the prescription sheet?	
		<b>Yes</b> <b>No</b>
	Patient's surname	<input type="checkbox"/> <input type="checkbox"/>
	Patient's first name	<input type="checkbox"/> <input type="checkbox"/>
	Date of birth	<input type="checkbox"/> <input type="checkbox"/>
	Gender of patient	<input type="checkbox"/> <input type="checkbox"/>
	Patient identification number	<input type="checkbox"/> <input type="checkbox"/>
4	Does the prescription specify:	
	Blood or blood component to be administered	<input type="checkbox"/> <input type="checkbox"/>
	Quantity to be given	<input type="checkbox"/> <input type="checkbox"/>
	Duration of the transfusion	<input type="checkbox"/> <input type="checkbox"/>
	Any special instructions e.g. Pre-medication required	<input type="checkbox"/> <input type="checkbox"/>
	Date	<input type="checkbox"/> <input type="checkbox"/>
	Doctor's signature	<input type="checkbox"/> <input type="checkbox"/>
	Is there a policy in place for the doctor to inform:	
	The patient of indication for blood transfusion	<input type="checkbox"/> <input type="checkbox"/>
	Its risks and benefits	<input type="checkbox"/> <input type="checkbox"/>
	His/her right to refuse the blood transfusion	<input type="checkbox"/> <input type="checkbox"/>
	The alternatives to a blood transfusion	<input type="checkbox"/> <input type="checkbox"/>
5	Who is responsible for checking identity of patient and unit of blood?	
6	How many staff are required to check the identity of the patient and unit of blood?	

7	Outline the checking procedure for positively identifying patient	
8	Are patients receiving a red cell transfusion required to have an identification wrist band?	Yes <input type="checkbox"/> No <input type="checkbox"/>
9	What information is contained on this wrist band?	
10	<p>Are the following details checked?</p> <p style="padding-left: 20px;">Patient's surname</p> <p style="padding-left: 20px;">Patient's first name</p> <p style="padding-left: 20px;">Gender of patient</p> <p style="padding-left: 20px;">Date of birth</p> <p style="padding-left: 20px;">Patient's identification number</p> <p>Must these details be identical on the following pieces of documentation?</p> <p style="padding-left: 20px;">Patient's identification wrist band</p> <p style="padding-left: 20px;">Blood transfusion compatibility report form</p> <p style="padding-left: 20px;">Compatibility label attached to the blood pack</p> <p style="padding-left: 20px;">Prescription chart</p> <p style="padding-left: 20px;">Medical notes</p>	<p>Yes      No</p> <p><input type="checkbox"/>      <input type="checkbox"/></p> <p><input type="checkbox"/>      <input type="checkbox"/></p> <p><input type="checkbox"/>      <input type="checkbox"/></p> <p><input type="checkbox"/>      <input type="checkbox"/></p> <p><input type="checkbox"/>      <input type="checkbox"/></p> <p><input type="checkbox"/>      <input type="checkbox"/></p> <p><input type="checkbox"/>      <input type="checkbox"/></p> <p><input type="checkbox"/>      <input type="checkbox"/></p> <p><input type="checkbox"/>      <input type="checkbox"/></p>
11	Is the blood group and unit number applied by the Blood Transfusion Service checked when unit of blood is checked?	Yes <input type="checkbox"/> No <input type="checkbox"/>
12	Must the blood group and unit number applied to the blood pack be found to be identical to that on the blood transfusion compatibility report form?	Yes <input type="checkbox"/> No <input type="checkbox"/>
13	In the event of the blood group of the unit and the patient not being identical what further documentation is required from blood bank?	

14	In the event of the blood group of the unit and patient not being identical, and no comment to indicate that the blood is compatible from blood bank, what action is taken by nursing staff?	
15	Is unit of blood checked for compliance with any special requirements on the prescription sheet?	Yes <input type="checkbox"/> No <input type="checkbox"/>
16	Is the unit of blood checked to ensure that it is not past its expiry date?	Yes <input type="checkbox"/> No <input type="checkbox"/>
17	Who signs blood transfusion compatibility report form and prescription sheet in the patient's notes?	
18	How many members of staff carry out the above checking procedure?	
19	Is the date and time of commencement of transfusion of each unit of blood recorded on the blood transfusion compatibility report form	Yes <input type="checkbox"/> No <input type="checkbox"/>
20	Is the date and time of commencement of the transfusion of blood recorded on the blood transfusion prescription sheet?	Yes <input type="checkbox"/> No <input type="checkbox"/>
21	In the event of discrepancies during the checking procedures what action is taken by nursing staff?	
22	Where does the check of patient unit of blood take place?	
23	Is the blood transfusion compatibility report readily available at all times during the transfusion?	Yes <input type="checkbox"/> No <input type="checkbox"/>
24	Is the blood transfusion compatibility form fixed to the patient's notes as a permanent record of the transfusion?	Yes <input type="checkbox"/> No <input type="checkbox"/>
25	Is a doctor readily available for the first five minutes of a red cell transfusion?	Yes <input type="checkbox"/> No <input type="checkbox"/>

**Part3**

Technical aspects of the administration of blood and blood components

1	Is blood transfused through a sterile giving set dedicated for blood transfusion?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
2	Are electronic infusion pumps used for transfusion of red cells?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
3	Is there a minimum or maximum size of cannula for transfusion of red cells?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
4	Specify:  Is the blood ever warmed before giving the transfusion and if so how is this done?   What are the conditions in the ward for storage of red cells?		
5	How long may blood be left out of the fridge before use?		
6	What drugs if any may be added to a red cell transfusion?		
7	What solutions may be used immediately before and after unit of blood?		
8	Is there a maximum duration for transfusion of unit of red cells?		
9	Is there a maximum duration of transfusion before the giving set is changed?		
10	Is the giving set changed if another infusion is to continue after the transfusion?		
11	Are empty blood packs retained after the transfusion?		
12	If blood packs are retained after transfusion for how long?		
13	What is the procedure for discarding empty blood packs after their period of retention?		
14	Is a blood transfusion compatibility report form filed in the patient's notes?		
15	Is there a mechanism for return of unused blood to the hospital blood bank?		
16	What action is taken if a red cell transfusion overruns its prescribed time?		

**Part 4**

A: Care and monitoring of transfused patients

1	Who is responsible for the care and monitoring of patients receiving a transfusion?	
2	Who is responsible for measuring patient's vital signs during the transfusion?	
3	Who is responsible for informing the patient about possible adverse effects of transfusion?	
4	Who is responsible for informing the patient about the importance of reporting immediately any adverse events?	
5	At what times are observations recorded when patients are receiving red cell transfusion?	
6	What vital signs are recorded?	

B – Management and reporting of adverse events

1	What action is taken in the event of a transfusion reaction reported by the patient?	
2	If a severe reaction is suspected is the transfusion stopped?	Yes <input type="checkbox"/> No <input type="checkbox"/>
3	Is urgent medical advice sought?	Yes <input type="checkbox"/> No <input type="checkbox"/>
4	Is the blood administration set changed and venesection maintained using normal saline?	Yes <input type="checkbox"/> No <input type="checkbox"/>
5	Is the reaction reported immediately to the hospital blood bank?	Yes <input type="checkbox"/> No <input type="checkbox"/>
6	Is the blood remaining in the bag or the delivery tubing returned to the laboratory for testing?	Yes <input type="checkbox"/> No <input type="checkbox"/>
7	What blood samples from the patient are required by the laboratory?	
8	Who is responsible for measuring the patient's vital signs?	
9	Is the volume and colour of any urine passed recorded?	Yes <input type="checkbox"/> No <input type="checkbox"/>
10	Are all adverse events relating to blood transfusion reported to the hospital blood bank	Yes <input type="checkbox"/> No <input type="checkbox"/>
11	In the event of a severe reaction being suspected is medical advice from a haematologist sought?	Yes <input type="checkbox"/> No <input type="checkbox"/>

**Part 5**

Documentation of transfusions:

1	<p>Is the following information recorded in the patient's medical notes:</p> <p style="text-align: right;"><b>Yes</b>                      <b>No</b></p> <p style="padding-left: 40px;">Blood transfusion compatibility report form                      <input type="checkbox"/>                      <input type="checkbox"/></p> <p style="padding-left: 40px;">Sheet used for the prescription of blood                      <input type="checkbox"/>                      <input type="checkbox"/></p> <p style="padding-left: 40px;">Nursing observations recorded during the transfusion                      <input type="checkbox"/>                      <input type="checkbox"/></p> <p style="padding-left: 40px;">Is an entry made in the case notes describing the indication for the use of blood?                      <input type="checkbox"/>                      <input type="checkbox"/></p> <p style="padding-left: 40px;">Is an entry made in the case notes recording the date, number and type of blood components used?                      <input type="checkbox"/>                      <input type="checkbox"/></p> <p style="padding-left: 40px;">Is there an entry made in the case notes recording whether or not the blood component achieved the desired effect and the occurrence and management of any adverse events?                      <input type="checkbox"/>                      <input type="checkbox"/></p>
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**Part 6**

Definition of responsibilities

1	Are medical staff solely responsible for prescribing blood?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
2	Are medical staff solely responsible for ensuring adequate documentation of blood transfusion in the medical notes?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
3	Are medical staff responsible for reporting transfusion reactions or other adverse events related to transfusion?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
4	Do medical staff inform the patient of	<b>Yes</b>	<b>No</b>
	Indication for blood transfusion?	<input type="checkbox"/>	<input type="checkbox"/>
	Its risks and benefits	<input type="checkbox"/>	<input type="checkbox"/>
	His/her right to refuse the blood transfusion	<input type="checkbox"/>	<input type="checkbox"/>
	Alternatives to a blood transfusion	<input type="checkbox"/>	<input type="checkbox"/>
5	Which grades of staff carry out the following tasks:		
	Request blood and blood components		
	Take blood samples for compatibility testing		
	Carry out the procedure for the administration of blood and blood components		
	Monitor patient during the blood transfusion		
	Carry out appropriate actions if an adverse effect occurs		



**GUIDELINES**

**FOR**

**MANAGEMENT OF**

**ACUTE MASSIVE BLOOD LOSS**



## **GUIDELINES FOR THE MANAGEMENT OF ACUTE MASSIVE BLOOD LOSS**

### **Introduction:**

Fortunately acute massive blood loss is relatively uncommon. When it occurs however, early recognition with corrective action, by appropriate personnel, is vital if the patient is to survive.

Within the definitions given there are two distinct sub-categories which should be considered. The first is the loss of one blood volume within 24 hours, and there is time to evaluate and respond to laboratory investigation. This is in contrast to the second category in which the rate of loss is much more rapid and volume depletion is a critical factor. In this second group, attendant personnel may well have to treat empirically before the result of investigations are available. Immediate availability of expert haematological advice and the distance from a supply of blood components will influence the degree of empiricism required.

Management of acute massive blood loss involves total patient care. Outcome depends on multiple factors of which the principles of transfusion medicine are only one, albeit very important, aspect.

The factors in each sub-category differ. It is probably in consequence of this, that audits of management of acute massive blood loss relate to single aspects of component therapy in the acute volume replacement category. Current evidence based guidelines relate more to the former category and are not necessarily applicable to the rapid volume depletion group.

Haematological texts tend to relate to the rate of blood loss in the former group, for which the advice given in current guidelines is entirely appropriate. The apparent contention, between emergency service personnel (anaesthetists and surgeons) and haematologists, in the protocol for management of “massive blood loss” is due not only to failure to recognise the separate priorities and requirements in each category but also to the lack of true audit-based evidence for management of the latter category of acute massive blood loss.

In these guidelines, evidence based recommendations have been given where they exist. In the absence of audited evidence, current consensus practice has been quoted.

Suggestions for audit of management of massive blood loss have been included in this document and are commended to the reader.

## GUIDELINES FOR THE MANAGEMENT OF ACUTE MASSIVE BLOOD LOSS

### Summary:

The guidelines offer guidance on the management of acute massive blood loss. If potentially avoidable deaths are to be prevented, anaesthetists, A&E specialists, surgeons, emergency physicians, haematologists, radiologists, laboratory and support staff must act, when called upon, as a co-ordinated group. **The goal is early haemostasis with restoration of an adequate circulating volume by appropriate fluid and blood component replacement.**

Hospital “transfusion policies” should be developed by the transfusion committee and represent staff consensus. Annual review is highly desirable.

### Definition:

*Massive blood loss may be defined as:*

- Loss of **one blood volume within a 24 hour period.**  
(7% of lean body weight (5 litres in an adult) – 8 to 9% in a child).
- Loss of **50% of blood volume within 3 hours.**
- Loss of blood **at a rate in excess of 150 ml. per minute.**

### Priorities:

- Restoration of circulation to re-establish adequate perfusion.
- Haemostasis of visual bleeding points.
- Integrated care, by appropriate staff, including Anaesthetists, A&E, General and Gynaecological Surgeons, Emergency Physicians, Laboratory, Radiological and support staff, leading to early active intervention.
- **Positive patient identification and documentation of care.**

### Resuscitation:

- **Principles of airway management and resuscitation apply.**
- **Arrest visible haemorrhage: replace blood volume** by rapid infusion of **WARM** crystalloids and/or colloids through multiple large bore cannulae.
- **Transfuse preferably fully crossmatched blood**, if time permits, or **if irregular antibodies are known to be present.**  
Alternatively, if more urgent, **uncrossmatched group specific blood** should be given if 1/3 of the patient’s estimated blood volume has been lost. In extreme emergency use group **O Rhesus D negative blood**. **O Rhesus D positive** blood is acceptable for post menopausal female and male patients.
- **AVOID HYPOTHERMIA** by using fluid warmers.

### Laboratory investigations:

- Arrange for **early initial, and serial assessment of FBC; blood gas analysis, blood biochemistry and a Coagulation Screen.**
- **Blood group and cross match Packed Cells** (8 Units for an adult – pro.rata. for a child). **Further**

**crossmatch is not required after replacement of 1 blood volume (8 Units in adults) as the cells by then are unrepresentative.**

- **Repeat estimations every 4 hours, or more frequently, after component therapy.**

**Blood Component Therapy:**

*Red cells:*

Red cells transfused in optimal additive solution contain no plasma or other cellular fractions. Dilutional coagulopathy may occur.

*Platelets:*

Platelet levels will fall due to blood loss and haemodilution and should be anticipated when **volume replacement exceeds 1.5 times the estimated total blood volume**. Replacement should be considered **early rather than late**. **Serial** estimations, a level of  $50 \times 10^9$  per litre, or **active bleeding** will indicate a need for transfusion. Following major trauma or in head injury, platelet levels of  $100 \times 10^9$  per litre should be maintained. Average replacement, if required, would be @ 1–2 **Adult Therapeutic Doses** (ATDs) (equivalent to 5/10 “old packs”) for a 70 kg. patient. If possible discuss the problem with a specialist in haematology before initiating treatment.

*Cryoprecipitate:*

Cryoprecipitate is a blood fraction containing concentrated **fibrinogen (factor 1), fibronectin, factor VIII and Von Willebrand Factor and is the definitive therapy** in fibrinogen deficiency. Serial estimations of fibrinogen, PT and APPT are mandatory. **Fibrinogen levels should be maintained above 1 g/l**. Average replacement would be 1 unit/5 kg. body weight (15 to 20 units for an adult).

*Fresh frozen plasma (FFP):*

FFP is indicated in **Acute Disseminated Intravascular Coagulation (DIC)** or during **Massive Transfusion** where DIC is anticipated. When **PT and APPT are prolonged to more than 1.5 times control values but fibrinogen levels are greater than 1 g/l and there is active bleeding, then transfusion @ 12–15 ml/kg** (approximately 4 packs for an adult) will increase levels of the **required coagulation factors**. The potential risk of blood borne infection, including HIV and hepatitis, from transfusion of FFP is similar to that for whole blood. Although “formula replacement” is not recommended it has been suggested that FFP should be considered after loss of one blood volume.

*Acute Disseminated Intra-vascular Coagulation (DIC):*

This is one of the serious early complications of massive haemorrhage. Contributory factors to, and evidence of DIC include:

- Hypothermia.
- Prolonged hypovolaemia and hypoxia.
- Low levels of coagulation factors including **Factors V, VIII and fibrinogen**.
- Thrombocytopenia.

Haematological evidence of **prolonged PT, APPT with thrombocytopenia and fibrinogen levels < 1 g/l** are highly suggestive of impending DIC. A “wet” surgical field with microvascular bleeding is a late sign of the complication.

*Management:*

- Avoid predisposing factors.
- Warm resuscitation fluids.
- Frequent serial estimation of
  - Platelets.
  - Fibrinogen.
  - Coagulation screen.
- Aggressive early intervention with appropriate blood component therapy will optimise chance of recovery.
- **SEEK EARLY HAEMATOLOGICAL ADVICE**

**DO NOT FORGET TO ADVISE THE LABORATORY WHEN THE EMERGENCY IS OVER!**

***FURTHER READING:***

*Guidelines for transfusion for massive blood loss.*  
*A publication of the British Society for Haematology.*  
*Clinical and Laboratory Haematology 10: 265–273, 1988.*

*Guidelines for the use of Fresh Frozen Plasma.*  
*British Committee for Standards in Haematology.*  
*Working Party of the Blood Transfusion Task Force.*  
*Transfusion Medicine 2: 57–63, 1992.*

*Handbook of Transfusion Medicine.*  
*Blood Transfusion Services of the United Kingdom.*  
*Second Edition 1996. Editor Brian McClelland.*

*Editorial: Multiple Trauma and Massive Transfusion.*  
*Horsey P.J. Anaesthesia 52 : 1027–1029, 1997.*

*SHOT. Serious Hazards of Transfusion.*  
*Summary of Annual Report 1997–98.*

*Management of Massive Blood Loss.*  
*A Template Guideline with Commentary.*  
*Stainsby D.; MacLennan S.; Hamilton P.J. (In press).*

*ATLS (American College of Surgeons Advanced Trauma Life Support) Manual.*  
*American College of Surgeons 1997, Chicago.*

## MANAGEMENT OF ACUTE MASSIVE BLOOD LOSS (Wall Chart)

Apply principles of resuscitation.  
Control visible haemorrhage by direct pressure and elevation, if appropriate.

Restore circulating volume and blood pressure as rapidly as possible, using multiple wide bore cannulae – **preferably 14 s.w.g. – or larger.**

**Seek URGENT APPROPRIATE SUPPORT including – anaesthetic, A&E, surgical and emergency medical support.**

**Alert laboratory and radiological services.**

**Alert theatre staff.**

ENSURE CORRECT PATIENT IDENTITY.

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Request blood components as required.  
Remember that:

- Cryoprecipitate and FFP may require 30 minutes to thaw.
- Platelets must come from a central laboratory.

**RED BLOOD CELLS**

**(After 8 units of blood have been transfused, group specific uncross-matched blood will be issued). The pre-transfusion sample will be unrepresentative.**

**PLATELETS**

**Dosage:**

- **1-2 adult therapeutic doses (equivalent to 5-10 ‘old packs’ for a 70 kg adult)**

**CRYOPRECIPITATE**

**Dosage:**

- **1 unit/5 kg body weight. (15–20 units for an adult)**

**FRESH FROZEN PLASMA**

**Dosage:**

- **12-15 ml/kg body weight (4 packs for an adult)**

**(Seek haematological advice)**

**Monitor BP; CVP and maintain urine output at 0.5ml/kg/hr in adults: 1 ml/kg/hr in children.**

**Use WARMED crystalloids; colloids and blood, via a pressure driven warming device.**

Draw blood samples as soon as possible for:-

- FBP; Biochemistry; blood gas analysis.
- PT; APPT; Fibrinogen and coagulation screen.
- **Blood group and cross-match RBC 8 units for an adult – pro rata for a child. Send 2-3 cross match tubes if possible.**

**REPEAT AS SERIAL ESTIMATIONS** every 4 hours or more often, as necessary after component therapy.

**Transfuse fully cross-matched blood** if time permits **or if irregular antibodies are known to be present.**

Use **uncross-matched, group specific blood** in emergency, if the group is known.

Only use group O, Rh D negative blood in **extreme emergency.**

**ANTICIPATE THROMBOCYTOPENIA.**

Be prepared to request platelets in advance of need if there has been multiple trauma, head injury, abnormal platelet function (aspirin) or persistent active bleeding.  
**Target values are 50 x 10<sup>9</sup>/l but 100 x 10<sup>9</sup>/l for head injury or major trauma.**

**ANTICIPATE COAGULOPATHY**  
**Base treatment on need to:-**

- Maintain fibrinogen level above 1 g/l.
- Maintain PT and APPT less than 1.5 times control value
- Stop persistent active bleeding

Action       Advisory









**GUIDELINES  
FOR  
USE OF BLOOD COMPONENTS  
IN  
OBSTETRICS**



## GUIDELINES FOR USE OF BLOOD COMPONENTS IN OBSTETRICS

### Introduction

Antepartum and Postpartum haemorrhage continues to feature prominently as a direct cause of maternal death in the triennial Reports on Confidential Enquiries into Maternal Deaths in the United Kingdom<sup>1-2</sup>. Evidence from other countries<sup>3</sup> and 'near miss' investigations<sup>4</sup> suggest that life-threatening haemorrhage occurs in 1 in 1,000 deliveries, indicating that there are approximately 25 cases of life-threatening obstetric haemorrhage in Northern Ireland per annum. The most recent triennial report '*Why Mothers Die*' has stated that every delivery unit must have a protocol for the management of massive haemorrhage<sup>2</sup>, and comprehensive guidelines for the management of postpartum haemorrhage are available<sup>5</sup>.

During pregnancy, the haemoglobin concentration falls because the physiological increase in plasma volume is greater than that of the red cell mass. In spite of improved nutrition and reduction in parity of the obstetric population, anaemia still occurs, but prophylactic oral supplementation with iron and folate in all pregnant women is not supported by trial data.

These guidelines are intended to address the wide variation in clinical practice between individual obstetricians and maternity units with regard to crossmatching and transfusion of blood. Unpublished audit data suggest that many obstetric patients are 'group and held' or crossmatched unnecessarily and that a significant proportion of blood units requested for transfusion are returned to the blood bank unused. In the context of Northern Ireland, account has been taken of the geographical proximity of obstetric units to blood bank facilities.

## **GUIDELINES FOR USE OF BLOOD COMPONENTS IN OBSTETRICS**

### **REFERENCES**

1. Hibbard, B *et al.* Report on Confidential Enquiries into Maternal Deaths in the United Kingdom 1988–1990. London: HMSO, 1994.
2. Drife, J., Lewis, G. *et al.* Why Mothers Die. Report on Confidential Enquiries into Maternal Deaths in the United Kingdom 1994–1996. London: The Stationery Office, 1998.
3. Drife, J. Management of Primary Postpartum Haemorrhage. *British Journal of Obstetrics and Gynaecology* 1997, 104, 275–277.
4. Mantel, G., Buchmann, E., Rees, H. and Pattinson, R. C. Severe acute maternal morbidity: a pilot study of a definition for a 'near-miss'. *British Journal of Obstetrics and Gynaecology* 1998; 105, 985–990.
5. The Management of Postpartum Haemorrhage – A Clinical Practice Guideline for Professionals Involved in Maternity Care (1998). Scottish Programme for Clinical Effectiveness in Reproductive Health, Aberdeen.
6. Guidelines for Obstetric Anaesthesia Services (1998). The Association of Anaesthetists of Gt. Britain & Ireland/The Obstetric Anaesthetists Association. Alresford Press Ltd.

## GUIDELINES FOR USE OF BLOOD COMPONENTS IN OBSTETRICS

### Wall Chart

- A. All booked patients should have their Blood Group and Antibodies status checked antenatally at least once.
- B. Crossmatching of blood should be requested in the following circumstances:
1. Significant antepartum, intrapartum or postpartum haemorrhage.
  2. Placenta praevia.
  3. Severe pre-eclampsia or eclampsia.
  4. Significant coagulation abnormalities.
  5. Anaemia (Haemoglobin less than 10 g/dl.) prior to caesarean section.
  6. Pre-operatively in the presence of significant obstetric abnormalities such as uterine fibroids, previous Classical caesarean section or previous placenta accreta.
- C. In the absence of the above conditions, provided the blood group and antibody status are known, it is sufficient to “Group and Hold” in the following circumstances:
- 1 Elective or emergency caesarean section.
  - 2 Manual removal of placenta not complicated by postpartum haemorrhage.
  - 3 Elective surgical management of missed abortion.
  - 4 Anaemia (Haemoglobin < 10 g/dl.) prior to anticipated vaginal delivery.
- D. The following principles should be observed:
- 1 Obstetric Units should always have Group O Rhesus D negative, Kell negative blood readily available and suitable for emergency use.
  - 2 In emergency circumstances, uncrossmatched group specific blood is preferable to Group O Rhesus D negative blood, and should be substituted as early as possible.
  - 3 In the absence of acute blood loss, antenatal and postnatal patients should only be transfused in exceptional circumstances, where the haemoglobin is low and associated with symptoms.
  - 4 In the presence of coagulation failure, the advice of a haematologist should be sought.
  - 5 In the event of massive transfusion being required, refer to relevant CREST guidelines and seek haematology advice.
  - 6 When special transfusion needs arise or are anticipated, there should be early consultation with the supplier i.e. the Northern Ireland Blood Transfusion Service.

Implementation of these guidelines in Obstetric Units is recommended as a subject for prospective audit.

**Patient's I.D.**

## GUIDELINES FOR USE OF BLOOD COMPONENTS IN OBSTETRICS

**AUDIT PROFORMA**

**YES/NO  
OR TICK**

- |  |                          |
|--|--------------------------|
| <p>1. Was the patient's ABO and Rhesus Blood Group with antibody status known beforehand?</p>  | <input type="checkbox"/> |
| <p>2. How many units of blood were crossmatched?</p>   | <input type="checkbox"/> |
| <p>3. Indication(s) for crossmatching:</p> <ul style="list-style-type: none"> <li>a) APH <span style="float: right;"><input type="checkbox"/></span></li> <li>b) Intrapartum Haemorrhage <span style="float: right;"><input type="checkbox"/></span></li> <li>c) P.P.H. <span style="float: right;"><input type="checkbox"/></span></li> <li>d) Placenta Praevia <span style="float: right;"><input type="checkbox"/></span></li> <li>e) Severe pre-eclampsia or eclampsia <span style="float: right;"><input type="checkbox"/></span></li> <li>f) Coagulation failure <span style="float: right;"><input type="checkbox"/></span></li> <li>g) Anaemia <span style="float: right;"><input type="checkbox"/></span><br/>                     If yes, specify haemoglobin concentration _____ g/dl</li> <li>h) Other obstetric complications <span style="float: right;"><input type="checkbox"/></span><br/>                     If yes, specify</li> </ul> <div style="border: 1px solid black; height: 30px; width: 600px; margin-top: 5px;"></div> |                          |
| <p>4. Was the patient transfused?</p>  | <input type="checkbox"/> |
| <p>5. If yes. how many units were transfused?</p>  | <input type="checkbox"/> |
| <p>6. If yes, what blood components were given?</p> <ul style="list-style-type: none"> <li>a) Whole blood <span style="float: right;"><input type="checkbox"/></span></li> <li>b) Packed red blood cells <span style="float: right;"><input type="checkbox"/></span></li> <li>c) Fresh frozen plasma <span style="float: right;"><input type="checkbox"/></span></li> <li>d) Platelets <span style="float: right;"><input type="checkbox"/></span></li> </ul>  |                          |
| <p>7. In the case of an anaemic patient, was she symptomatic?</p>  | <input type="checkbox"/> |

8 If you answered yes to Q7, specify symptoms:

- a) Tiredness
- b) Dyspnoea at rest
- c) Other – specify

9. Was Hb rechecked after transfusion?

10. Did the patient experience a transfusion reaction?  
If yes, specify

11. Where was the transfusion commenced?

- a) Antenatal Ward
- b) Delivery Suite
- c) Operating Theatre
- d) Recovery Ward
- e) Postnatal Ward
- f) Gynaecology Ward
- g) Other – specify

12. Was massive transfusion required?

13. Was acute blood loss complicated by coagulation failure?

14. Was Uncrossmatched Group Specific or Group O Rhesus  
Negative blood used?

15. Was a haematologist's advice sought?

16. Any comments:





# **GUIDELINES FOR NEONATAL TRANSFUSION**



## GUIDELINES FOR NEONATAL TRANSFUSION

### Introduction

Neonates in intensive care units are one of the most transfused patient groups. Because of their potential normal life expectancy they are more susceptible to the long term effects of blood transfusion. Care and attention should be given to avoiding donor exposure and also to avoiding iatrogenic blood loss which is a major contributor to anaemia in this group. If a transfusion is required it should be of adequate volume to reduce the need for repeat transfusions and hence multiple donor exposure.

### Red Cell Transfusion

There is a lack of good quality clinical data in this area<sup>1-5</sup>. Red cell transfusions should only be given to improve oxygenation, prevent tissue hypoxia or replace acute blood loss. Transfusion of red cells to a predetermined target Hb is not ideal practice but is often used for practical reasons. Where there are associated symptoms and these are documented, then transfusion for a lowered Hb can be more easily justified.

Suggested thresholds are Hb = 10.5 g/dl for a neonate with symptoms and a higher threshold Hb = 13.0 g/dl in the presence of pulmonary or cardiac disease or where supplemental O<sub>2</sub> therapy is being administered<sup>6</sup>. Lower thresholds, e.g. Hb = 7.0 g/dl can be applied in anaemia of prematurity.

Neonates should be sampled as infrequently as possible and maximum use should be made of micro techniques for blood analysis.

Erythropoietin (EPO) has been used in clinical trials and shows some benefit in avoiding donor exposure after the first two weeks of life.

### Source of Blood for Transfusion

Blood components from volunteer non-remunerated community blood donors should be used. Walk-in blood donor programmes are to be discouraged. Directed blood donations are not necessarily safer and because of the pressure to donate there is some evidence of concealment of risk factors. Maternal transfusions are occasionally indicated in the absence of a suitable compatible blood component. Maternal transfusions must be gamma irradiated to abrogate the risk of transfusion associated graft versus host disease (TaGVHD)<sup>7</sup>.

### Pre Transfusion Testing

Naturally occurring anti-A and anti-B do not develop before six months of age. Also neonates very rarely form irregular red cell antibodies before six months.<sup>8</sup> Anti-A, Anti-B and other red cell antibodies are passively derived. It is sufficient therefore to ABO group and Rh D type the newborn up to age four months on two occasions only. Donor red cells should be cross matched against maternal serum on the first two occasions.<sup>7</sup>

Where there is secure data management using validated IT software and secure patient identification systems in place, cross matching for third and subsequent samples in this period is not necessary. Adopting such a policy will help greatly in avoiding iatrogenic blood loss due to sampling. There is some evidence that repeated massive transfusions and the use of relatively fresh blood can induce alloantibody

formation in neonates less than four months of age. In these circumstances consideration can be given to repeating antibody screening and performing a serological cross match. If the maternal antibody screen is positive and/or the newborn is direct antiglobulin test positive then full serological investigation and compatibility testing will be necessary. After the first four months of life, compatibility testing should conform to the requirements for adults as described in BCSH Guidelines.<sup>9</sup>

## **PRESENTATION OF RED CELL PRODUCTS**

### **Small Volume Transfusion (up to 15-20 ml/kg)**

Red cells collected into optimal additive solution (OAS) which contains SAG-M (saline adenine glucose – mannitol) are suitable for this indication. Maximum use should be made of paedipacks where one blood donation is divided into six to eight aliquots enabling repeated transfusions to be given from one blood donation up to the date of expiry.

### **Exchange Transfusion**

There are theoretical risks concerning adenine in OAS when given as large volume transfusions to small neonates. There are also risks concerning increased K<sup>+</sup> load as there is K<sup>+</sup> leak from stored red cells which increases significantly after the first week. These considerations are largely theoretical and mathematical models suggest that dangerous levels of adenine and K<sup>+</sup> cannot be reached.<sup>10</sup>

However, red cells collected into plasma and CPD A1 are preferred for this indication and blood less than five days from collection is also specified.

### **Intrauterine Transfusion**

Red cell components prepared for intrauterine transfusion are usually Group O Rh D negative collected into plasma and CPD A1, less than five days from collection, cross matched against maternal serum, leucodepleted, CMV antibody negative and  $\gamma$  irradiated.<sup>7</sup>

BCSH guidelines mandate that all red cells transfused to infants less than 12 months should be leucodepleted.<sup>11</sup> This mandate has been overtaken by events in that all red cell components prepared by UK Blood Transfusion Services are now leucodepleted, effective 01.11.99.

### **Administration of Red Cell Transfusions**

Volume considerations are particularly important in small volume recipients, i.e. neonates. Transfusion rates must therefore be carefully controlled. Volumes of up to 5mls/kg/hr are regarded as safe. Increased rates could be selected in the presence of active haemorrhage and decreased rates can be used when there is a risk of cardiac failure. Red cells should be maintained between 2-6 °C. The temperature should not be outside this range for greater than 5 hours. Red cell transfusions can be given via a syringe pump but certain types of pumps, i.e. piston pumps, are associated with greater red cell haemolysis. Diaphragmatic pumps are preferred. A filter assembly should be integral to the blood administration set up and a 20 $\mu$ m screen filter will suffice. For larger volumes a blood administration set incorporating a calibrated burette reservoir is convenient.<sup>6</sup>

Blood warmers may be used for rapid blood replacement, e.g. exchange transfusion, but these should be approved and have a record of service and maintenance.<sup>6</sup>

## **PLATELET TRANSFUSIONS**

Most platelet transfusions are given for prophylaxis and in adult medicine there is controversy surrounding thresholds below which prophylactic platelets should be administered. It is permissible to have a more liberal policy in neonates as the consequences of catastrophic bleeding are arguably greater and thresholds of platelets =  $30 \times 10^9/l$  are suggested.<sup>12</sup> In children who are sick, febrile and premature a higher threshold platelet count =  $50 \times 10^9/l$  has been adopted.<sup>12</sup> Lower thresholds for neonates who are stable and not bleeding, e.g.  $10-20 \times 10^9/l$  should be explored. It is worth noting that 10ml/kg body weight is usually sufficient to increment the platelet count and consideration should be given to avoiding unnecessary donor exposure. An aliquot may be prepared from an apheresis pack and usually <50 ml will be required. Volume reduction of platelets should seldom be necessary. This is available from NIBTS as a non-conforming product. What is gained in volume reduction may be lost in reduced platelet function because of the method of preparation.

### **Feto-Maternal Alloimmune Thrombocytopenia (FMAIT)**

This diagnosis requires specialist advice for appropriate management. Compatible antigen negative platelets should be made available as first choice therapy. Other options include maternal platelets, (plasma reduced and  $\gamma$  irradiated), high dose intravenous immunoglobulin and high dose random platelet therapy.

### **Immune Thrombocytopenic Purpura (ITP)**

Intravenous immunoglobulin (IVIgG) is the treatment of choice in this condition. Platelet transfusions may be used as a prophylaxis for very severe thrombocytopenia, i.e.  $<10 \times 10^9/l$  and also where there is life threatening haemorrhage.<sup>12</sup> Large doses should be used as transfused platelets will absorb the platelet auto antibody and be cleared from the circulation.

### **Granulocyte Therapy**

There are anecdotal reports of clinical improvement with granulocyte therapy though no satisfactory controlled clinical studies. Granulocyte therapy may be used in the context of severe neutropenia, neutrophil count  $<0.5 \times 10^9/l$ , documented bacterial or fungal infection and failure to respond to appropriate antimicrobial therapy. Other therapies such as recombinant growth factors G-CSF and GM-CSF should be assessed. IV IgG has also been used in clinical trials for this condition.

Granulocyte therapy should be given in adequate doses and may be required twice daily. Granulocytes are usually obtained by leucopheresis but for small volume recipients may be harvested from buffy coats. Buffy coats are available untested and as a non-conforming product from NIBTS. Granulocyte concentrate should be  $\gamma$  irradiated and must be CMV antibody negative. They should also be red cell compatible as there is significant red cell contamination of granulocyte components.

### **Fresh Frozen Plasma (FFP)**

A clinical guideline for use of FFP is available.<sup>13</sup> The clearest indication for the use of FFP is the presence of a documented coagulopathy and clinical bleeding. Babies with severe intra-uterine growth retardation are often low in coagulation factors and may require fresh frozen plasma transfusions in addition to vitamin K therapy.

### **Treatment of Hypovolaemic Shock**

Crystalloid solutions may be used as initial therapy in term neonates. Colloid solutions including human albumin solutions are often used initially in pre-term neonates. Small volume products (100ml 4.5% and 50ml 20% albumin) are available. While the use of albumin can be justified, the concomitant use of FFP purely for the treatment of hypovolaemic shock cannot.

### **Special Hazards of Transfusion in Neonates**

Hypocalcaemia is now rare following the introduction of CPD A1 anticoagulant preservative solution. It is often a combination of a rapid transfusion of cold donor blood in the presence of liver impairment that can give rise to hypocalcaemia with or without symptoms. It is currently the practice to measure calcium before and after large volume transfusions, e.g. exchange transfusions. A sample may also be drawn during the transfusion and not sent but reserved for calcium estimation. Supplemental calcium gluconate is rarely indicated and should be given under carefully controlled conditions. An ECG monitor should be in place. Rebound hypoglycaemia is occasionally seen following large volume transfusion, e.g. exchange transfusion, but is usually self correcting and self limiting. Likewise thrombocytopenia can be a problem following exchange transfusion although this often reflects dilution and will self correct. The practice of administering platelets prophylactically in this context should be discouraged. Underlying DIC however must be excluded.

### **Transfusion Associated Graft Versus Host Disease (TaGVHD)**

This is a fatal complication of cellular blood transfusion in neonates with immunodeficiency and is also seen following intrauterine transfusion and in exchange transfusions subsequent to intrauterine transfusions. BCSH guidelines<sup>7</sup> mandate  $\gamma$  irradiation of cellular blood components in the above mentioned patient groups. In other cases of exchange transfusion  $\lambda$  irradiation is recommended provided this does not unduly delay the transfusion. There should be exposure to 25 Gy in all parts of the blood component and because of the increased  $K^+$  leak,  $\gamma$  irradiated red cells should be used within four days for top up transfusion and 24 hours for exchange transfusions.

$\gamma$  irradiation should also be used for HLA selected blood components and transfusions from relatives.  $\gamma$  irradiation of transfusions to very low birth weight babies (< 1500g) can be justified.<sup>14</sup>

### **CMV Infection**

The best evidence for the use of CMV antibody cellular components is in premature, very low birth weight babies (< 1500g) where the mother is CMV antibody negative.<sup>15, 16, 17</sup> CMV antibody negative cellular components are mandated for recipients <30 weeks of gestational age irrespective of the immune status of the mother (personal communication Professor H Halliday, RBHSC, Belfast). In other situations leucodepleted blood components may be considered an acceptable alternative to CMV antibody negative donations.<sup>18, 19</sup>

### **Necrotising Enterocolitis and T Activation**

Neonates with a diagnosis of necrotising enterocolitis are susceptible to T activation. Anti-T is widespread in donor plasma and with infusion of anti-T a haemolytic reaction can ensue.<sup>20, 21</sup> NIBTS has low titre anti-T plasma components available for this indication. Red cells and platelets for transfusions should be plasma reduced.

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# GUIDELINES FOR NEONATAL TRANSFUSION

## Wall Chart

### RED CELL TRANSFUSION

1. Miniaturise sampling/avoid iatrogenic blood loss.
2. ABO group, RhD type x 2 is sufficient for first four months of life.
3. Maximise use of paedipacks for small volume transfusions (<20ml/kg) to avoid donor exposure.
4. Transfuse for relevant symptoms (tachypnoea, tachycardia, recurrent apnoea, requirement for supplemental O<sub>2</sub>, poor feeding, failure to gain weight [ $<10\text{g/dl}$ ]).
5. Suggested transfusion triggers are:
  - (a) Hb = 13g/dl where pulmonary, cardiac disease/supplemental O<sub>2</sub>.
  - (b) Hb = 10.5g/dl where symptoms (see 4).
  - (c) Hb = 7.0g/dl is anaemia of prematurity.
6. Note additional special requirements for exchange transfusion, intrauterine transfusion and premature (<30/52), low birth weight (<1500g) recipients.

### PLATELET TRANSFUSION

1. Platelet dose is 10ml/kg
2. Aliquots of single donor apheresis platelets should be requested
3. Suggested transfusion triggers are:
  - (a)  $30 \times 10^9/\text{l}$  neonates not at increased risk of bleeding.
  - (b)  $50 \times 10^9/\text{l}$  sick, febrile, premature neonates. Consider lower threshold.
  - (c)  $10\text{--}20 \times 10^9/\text{l}$  neonates stable, not bleeding, platelet recovery likely.
4. Note additional special requirements for fetomaternal alloimmune thrombocytopenia, immune thrombocytopenic purpura.

### FRESH FROZEN PLASMA (FFP)

1. Indicated for documented coagulopathy with bleeding, may be indicated in severe intrauterine growth retardation.
2. Not indicated as volume expander, nutritional support or formula replacement.

## GUIDELINES FOR NEONATAL TRANSFUSION

The Guidelines for Use of Red Cell Transfusions can also be applied to neonatal transfusions

### Audit Proformas

Where fresh frozen plasma was transfused to a neonate, were the following documented?

1	Discussion with a haematologist	Yes <input type="checkbox"/>	No <input type="checkbox"/>
2	Coagulation screen	Yes <input type="checkbox"/>	No <input type="checkbox"/>
3	The reason for transfusion	Yes <input type="checkbox"/>	No <input type="checkbox"/>
4	Dose	Yes <input type="checkbox"/>	No <input type="checkbox"/>
5	The time for start and completion of the transfusion	Yes <input type="checkbox"/>	No <input type="checkbox"/>
6	Clinical response	Yes <input type="checkbox"/>	No <input type="checkbox"/>
7	Repeat coagulation screen	Yes <input type="checkbox"/>	No <input type="checkbox"/>

Where cryoprecipitate was transfused to a neonate, were the following documented?

1	Discussion with a haematologist	Yes <input type="checkbox"/>	No <input type="checkbox"/>
2	Coagulation Screen	Yes <input type="checkbox"/>	No <input type="checkbox"/>
3	Fibrinogen level	Yes <input type="checkbox"/>	No <input type="checkbox"/>
4	The reason for transfusion	Yes <input type="checkbox"/>	No <input type="checkbox"/>
5	Dose	Yes <input type="checkbox"/>	No <input type="checkbox"/>
6	Clinical response	Yes <input type="checkbox"/>	No <input type="checkbox"/>
7	Repeat coagulation screen	Yes <input type="checkbox"/>	No <input type="checkbox"/>
8	Repeat fibrinogen level	Yes <input type="checkbox"/>	No <input type="checkbox"/>

Where platelets were transfused to a neonate, were the following documented?

1	Platelet count before transfusion	Yes <input type="checkbox"/>	No <input type="checkbox"/>
2	The reason for transfusion	Yes <input type="checkbox"/>	No <input type="checkbox"/>
3	Dose	Yes <input type="checkbox"/>	No <input type="checkbox"/>
4	Clinical response	Yes <input type="checkbox"/>	No <input type="checkbox"/>
5	Post transfusion platelet count	Yes <input type="checkbox"/>	No <input type="checkbox"/>
6	Were the platelets from		
	(a) single apheresis donors	Yes <input type="checkbox"/>	No <input type="checkbox"/>
	(b) pooled platelets from more than one donor	Yes <input type="checkbox"/>	No <input type="checkbox"/>

Where paediatric pack was requested, were the following documented?

1	That satellite pack came from the unit dedicated to the recipient	Yes <input type="checkbox"/>	No <input type="checkbox"/>
2	The reason for transfusion	Yes <input type="checkbox"/>	No <input type="checkbox"/>
3	The reason the infant was likely to require multiple transfusions	Yes <input type="checkbox"/>	No <input type="checkbox"/>
4	Volume of blood transfused	Yes <input type="checkbox"/>	No <input type="checkbox"/>
5	Haemoglobin before transfusion	Yes <input type="checkbox"/>	No <input type="checkbox"/>
6	Haemoglobin after transfusion	Yes <input type="checkbox"/>	No <input type="checkbox"/>

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